Staging science on TV: *Richard Hammond's Invisible Worlds*, *Richard Hammond's Miracles of Nature*, and *Wild Weather with Richard Hammond*

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Abstract

This article comprises two distinct parts. The first surveys the problems and aspirations associated with television representations of science. This historical overview contextualizes the second part, which extrapolates from textual analysis of three closely related, high profile, peak-time BBC series. It seeks to demonstrate that, despite massive efforts and a shift in attitudes within the academy towards dissemination of knowledge over the last third of a century, many of them associated with initiatives in Public Understanding (or Awareness) of Science and Public Engagement in Science and Technology, there has been little progress in how scientific matters are represented.

Examination of extracts from the series argues that televised science draws upon the twin histories and discourses of the illustrated lecture and Victorian stage illusionism, each of which presented spectacle and sensationalism. Both utilised, in different ways, the pre-cinematic technology of the magic lantern. The former embodied the ideology of enlightenment; the latter exploited and perpetuated superstition and shamanism associated with natural philosophy.

Co-presence of such discourses and practices points to on-going ambivalence towards science. Consideration of editing structures, verbal rhetoric, and lighting, staging and mise-en-scene, as well as confusion between digital special effects and the evidential status of events captured on camera, support the claim that contradiction and inconsistency are neither new nor unusual. Attention to the programmes' construction and implicit informing ideologies reveals their divergence from the expository mode that they ostensibly claim to belong to.

The result is mystification and distraction at a time when science has revealed pressing issues at a global level, and inclusive rational debate is urgently required to address questions of sustainability and survival. While many Public Understanding efforts appear to involve a long-standing hermetic debate between scientists and journalists predicated on outmoded communications theories, textual analysis demonstrates that relatively unsophisticated television studies approaches may yet offer worthwhile contributions. Accordingly, the article uses minimal specialized terminology or advanced theory in order to be accessible to readers from other disciplines in the hope of encouraging mutual exploration.

Introduction

This article examines high-profile examples of British science television as part of a manifesto for investigation. Initial ideas were presented at the 2011 'London Film and Media Conference', held simultaneously with 'Londonicity:

The London Studies Conference'. At these combined events, six out of 73 papers about London mentioned science. None discussed scientific societies based there, or museums devoted to science, despite important discoveries reported in the capital, even if experimentation occurred elsewhere. Of 172 Film and Media papers, one panel considered representations of ecology alongside filmmaking's environmental impact; another examined health coverage; and a presenter, significantly with two Ph.Ds (Biochemistry and Film Studies) offered ecological interpretation of the movie *Inception* (Nolan, 2010). Of 245 presentations, ten addressed science.

That is not intended as criticism or rebuke of television, film, media, and cultural studies colleagues, but does raise questions of why these disciplines engage so rarely with representations of science. This seems strange when the BBC's *The Sky at Night* (1957-) has been the longest-running show with the same presenter and *Wonders of the Universe* (2011) drew six million British viewers to its first episode, later becoming the first factual programme to top the iTunes chart. Its broadcast audience was two-thirds that of the most popular soap operas and almost matched the science fiction adventure, *Doctor Who* (BBCtv, 1963-); these have run for decades, regularly attracting academic interest. With extraordinary amounts of European taxation funding the Hadron Collider; pressing issues such as population ageing, food security, climate change, and energy efficiency; high definition and wide-screen television creating opportunities for spectacular and aurally immersive programmes; and evident appetite for prestige productions to exploit that technology, it appears odd how little attention media academics grant science programmes. This is not to suggest there has been none; and the present

journal is an important intervention. But given the work on other, explicitly political, representations, examination of television science is hardly mainstream. The present concern is television studies, not philosophy of science, or sociology of science, or journalism training, each with different interests in science broadcasting.

Pioneering work appeared in the 1980s: Roger Silverstone's production case study (1985) of a documentary; and Carl Gardner and Robert Young's polemic essay for an influential media studies anthology (ed. Bennett et al., 1981). These advocated, crucially, questioning ideological acceptance of science as always progressive, presented in relation to viewers as consumers, and as always impacting society positively. Audiences were typically considered passive and science systematically ignored as a critical process, or as driven by political and commercial imperatives; its aims, methods and assumptions were insufficiently debated.

A 1985 report for the Royal Society in the United Kingdom resulted in the Committee on the Public Understanding of Science. This profoundly challenged attitudes towards dissemination of knowledge. 'Outreach' or 'popularization', so-called when managed by scientists rather than journalism and other media, became integral to research. This answered general Thatcherite insistence on accountability for, and 'relevance' of, taxpayer-funded activities. It also facilitated public relations during wide-scale privatization as universities increasingly depended on commercial income and discoveries that could be patented for profit. Many scientists had to satisfy the initiative to receive grants. Nevertheless, a cultural shift resulted: scientists

sharing expertise publicly became less likely to be perceived as aberrant – even if, the British House of Lords Select Committee on Science and Technology cautioned, ‘scientists who give time to outreach still risk losing standing among their peers’ (2000).

‘Public Understanding of Science’ (PUS), sometimes called ‘Public Awareness of Science’, has burgeoned. Complex issues are emphasised, often presenting controversial implications for ethics, funding and policy. Initiatives seek to educate researchers to communicate to non-specialists; educate journalists and broadcasters to understand concepts such as risk and probability; improve science education to enable voters to make informed decisions; and improve scientists’ image generally, to encourage youngsters to train for associated careers. As Stephen Hilgartner wrote, in the culturally-dominant view […] differences between genuine and popularized science must be caused by ‘distortion’ or ‘degradation’ of the original truths. Thus popularization is, at best, ‘appropriate simplification’ – a necessary (albeit low status) educational activity of simplifying science for non-specialists. At worst, popularization is ‘pollution’, the ‘distortion’ of science by such outsiders as journalists, and by a public that misunderstands […]. (1990, 519)

Related is ‘Public Engagement in Science and Technology’. UK public funding imposes statutory requirements to involve, as equals, non-specialists with knowledge pertaining to research and its application – not only science but fields such as architecture or road planning. A British Science Association web page illustrates the need by citing hill farmers affected after the 1986 Chernobyl disaster. Advice from Britain’s former Ministry of Agriculture,

Fisheries and Food erroneously assumed sheep eat only grass: danger of radioactivity entering the human food chain was therefore short-lived. As hill farmers and others futilely pointed out, sheep consume lichens and moss. Flocks that could safely have been disposed of remained, ingesting plants that concentrate radioactivity much more than officially predicted (Wakeford, 2007; Wynne, 1992). Some farms remained restricted for 26 years (BBC, 2012).

Public Understanding or Awareness differs from Public Engagement and other perspectives on science from within, beyond, or in opposition to its disciplines and suppositions. These include ‘Sociology of Science’, ‘Sociology of Scientific Knowledge’, ‘Science and Technology Studies’ (broadly interdisciplinary, established at University College London over a century ago), ‘History of Science’, and ‘Anthropology of Science’. Each has particular methodologies and assumptions, positivist or constructivist, vocational, democratic or radical; some at the heart of the scientific establishment, others hostile towards a ‘priesthood’ (Murcott, 2009; Ross, 1999) deemed to control the agenda and uncritical of political implications of funding and uses to which research is directed.

Media scholars accordingly should explore not (mis-)communication from scientists but representations: myths, ideologies, preconceptions and images informing fiction and non-fiction. Discursive formations are interpretive frameworks within which audiences understand and broadcasters mediate; or, less satisfactorily – within the process, or linear, model dominant among science communicators – baffles filtering and selectively modifying intended messages.

Textual analysis and reception studies can describe and critically interrogate the narratives, discourses, modes of address, codes and conventions, conceptual frames, implicit attitudes and assumptions of science on television. Alongside debating the truth of what is represented (the province of science itself), or rating efficiency or effectiveness of communication, an approach grounded in media analysis is needed. This should distinguish versions of science (and science communication) and investigate their social, political, economic, institutional, aesthetic, commercial, technological and other determinants.

Scientists have long condemned ignorance and misconception about their work. Clearly this implicates media representations. C. P. Snow's *The Two Cultures* (1959), alleging a rift between science and the humanities in the understanding of educated individuals, colours consequent debates. In spite of efforts to ameliorate or deny such binary opposition (e.g. British Academy, 2010; 2015a; 2015b), British policy following the 2010 Browne Review of higher education institutionalizes two cultures by differentially funding university courses. The problem partly has been professionalization and specialization over two centuries, with rapidly expanding knowledge and complex theories and methods. Science advanced beyond amateurs who previously constituted learned societies. Simultaneously, compulsory education raised questions about basic comprehension required for industrial and military supremacy and advancements in health and eradicating poverty. Aside from understanding to ensure informed citizenship, Governments continually argue its centrality to the national economy and international competitiveness.

These factors mesh with popular curiosity, fascination, and fear of the unknown evidenced in science fiction, appetite for lay-persons' history of science (e.g. Carey, 1995; Bryson, 2004), and *A Brief History of Time* (1988) becoming a bestseller and its author, Steven Hawking, an international celebrity. British public service broadcasters invest in prestigious series: the flagship documentaries *Horizon* (BBC2, 1964-); *The Ascent of Man* (BBC2, 1973), intended to complement *Civilisation* (BBC2, 1969), which considered art central to cultural evolution; *Tomorrow's World* (BBC1, 1965-2003); *The Human Body* (BBC1, 1998); and *Walking With Dinosaurs* (BBC1, 1999), the most expensive documentary per minute (Guinness World Records). Offsetting high production values against international sales, these epitomise patrician respectability associated with the BBC's mission to educate, entertain and inform. They are central to marketing and branding an institution required to demonstrate distinctiveness and quality while earning overseas income to justify compulsory licence funding.

Illumination, smoke and mirrors

These series and others – including *Cosmos* (1980), the American Public Broadcasting System's most viewed export – continue a historical tradition: the illustrated lecture. So, modestly, do the BBC's annual Reith Lectures on radio, named after the first Director-General who stamped his mark on the corporation, and which embody the legacy of his values; or the Royal Institution Christmas Lectures for young people, televised since 1966 but delivered originally by Michael Faraday in the 1820s.

The illustrated lecture has profoundly influenced documentaries. Particle physicist Brian Cox, who presented *Wonders of the Universe*, defended the series' allegedly overpowering soundtrack by insisting the experience was 'cinematic', not 'a lecture' (Hartley-Parkinson, 2011). Silverstone called the production he followed, 'a film, rather than an illustrated lecture' (1985, 17): its maker wanted to express a view, find a voice, rather than merely demonstrate a problem or process. In short, however, these distinctions are false. Bill Nichols observes, 'Every documentary has its own distinct voice' (2001, 99), generic as much as from an auteur; the 'modes' (101) Nichols identifies are heuristic classifications for tendencies, imposed on multidiscursive constructs.

Alongside scientific lectures developed another tradition, originally indistinguishable given common roots in science and magic. This utilised identical technology: the magic lantern. Illustrated lectures put optical apparatus centre stage, the attraction including marvellous precision engineering that took audiences on voyages to locations only the speaker had visited, or displayed microscopic bacteria or outer space. Magicians concealed the apparatus, as did clairvoyants and spiritualist mediums. Only as the nineteenth century ended did magicians unveil their equipment, making screenings a feature that crept up the programme as a discrete entertainment. The Lumières conceived cinematography to enhance scientific observation; yet moving pictures uncannily combined realism and illusion. For a century, magicians – and, from the 1840s, those who exploited the gullible in séances – had created Phantasmagoria more concerned with the lurid, frightening, Gothic underside to rationality, precursors to contemporary horror and fantasy. Some US channels, after all, censored *Walking with Dinosaurs*, made

with Computer Generated Imaging (CGI) developed for *Jurassic Park* (Spielberg, 1993), as too horrific.

Thus Britain's Channel 4 (1982-), originally meant to innovate, experiment, and serve minority interests but nowadays concerned with ratings in a competitive environment, courted controversy and benefited from advance publicity alleging sensationalism, when it broadcast live public autopsies, *Anatomy for Beginners* (Firefly Productions, 2005), and *Surgery Live* (Windfall Films, 2009), which interviewed in real-time a patient undergoing brain surgery. These appealed to fascination with intimacy, deviancy, and horror, explored in Jon Dovey's study of 'reality TV', *Freakshow* (2000), yet won praise for pushing boundaries of taste and decency for educational benefit.

Both aspects require investigation. Science by definition probes the unknown, eliciting fears and superstition alongside wonder and excitement, although these differ between eras. It is no use scientists treating society as benighted when suspicion lingers, if not direct repugnance, alongside fascination with their activities; especially if – although many scientists might deny it – their curiosity implicates similar voyeuristic desire to master the other. It cannot be coincidence that demonstrations, from the Age of Enlightenment to high school labs to televisual stunts, frequently seek attention through explosions and dazzling flashes, or that dissecting a rodent or frog is when many discover their vocation or are turned off for life.

Worthy aspirations

The House of Lords (2000) recommended that direct dialogue with the public should move from being an optional add-on to science based policy making and to the activities of research organisations and learned institutions, and should become a normal and integral part of the process.

The report advocated engagement with what the public actually believes and knows. However, science unsurprisingly continues with arcane rules, language, and forums for debate. Wider consideration of findings and implications are separate stages, mediating something already fixed rather than integral to the enquiry. This persists, despite relatively enlightened understanding of scientific communication that, nevertheless, ostensibly fails to consider in a sustained or academically rigorous way conditions for existing comprehension.

Several universities have high-profile 'public engagement' academics. The UK's most visible and ubiquitous, Royal Society research fellow, Manchester University professor and former pop star Cox, is a *Horizon* presenter. He features on the BBC6Music Breakfast Show; voices the BBC *Bitesize* schools' science revision programmes; co-presents with a stand-up comedian *The Infinite Monkey Cage* (BBC Radio 4, 2009-), popularizing science through humour; and, as well as fronting *Wonders of the Solar System* (BBC2, 2010) before extending further into the universe, he delivered the 2010 Royal Television Society Huw Wheldon Memorial Lecture (BBC2), 'Science: a Challenge to TV Orthodoxy'[1], which discussed media coverage and news about science. Cox also did not contradict interviewer Andrew Marr's claim

that anyone who does not understand science is uneducated (*Start the Week*, BBC Radio 4,14 March 2011).

Other attempts at humanizing science and technology include the BBC's Amateur Scientist of the Year competition, associated with Radio 4's *Material World* (1998-2013). Its website proclaimed 'Science is not a bank of knowledge. It's a way of knowing' – a declaration by Dr Adam Rutherford, editor for the journal *Nature*, which summarises the scientific method, emphasising creativity and serendipity: 'It's not just working scientists who have light bulb moments. Anyone, anywhere can have a brainwave that's worth investigating' (BBC Radio 4, 2010). Such sentiments contradict British research funding, which requires impact to be predicted. Radio 4 maintains programmes based on listeners' curiosity, such as *Questions Questions* (2011) and, with the Open University (OU), *More or Less* (2001-), which explores use and abuse of statistics but itself, lacking a wider agenda, is not above dubious, potentially damaging conclusions: such as, public transport is not necessarily environmentally-friendly because 'Buses, for example, are often fairly empty, increasing emissions per passenger' (BBC News Channel, 2010).

Television's *Bang Goes the Theory* (BBC1/OU, 2009-), and associated live events attracting hundreds of thousands, similarly answers viewers' enquiries. Its website contains videos of demonstrations repeatable at home, with notes explaining principles and laws. As the title suggests, it subordinates cerebral matters to spectacle and noise. Possibly it was conceived as an educational variant on *Brainiac: Science Abuse* (Granada for Sky Tv, 2004-8), which

rejected ‘Boring Science Videos’ and self-consciously ironized its relation to ‘science’ until cancelled after ratings fell, presumably because there are limited ways to blow up a caravan. Amongst the wacky fun, *Bang Goes the Theory* dealt little with hypotheses and testing, and less on applications. It is hardly a stretch to suggest it naturalized explosions as science’s inevitable corollary – potentially allaying fears about military research and development, or disastrous consequences of oil industry and nuclear accidents.

There have been many initiatives, but few from within television studies. Sage publish a journal, *Public Understanding of Science*, covering all aspects of the inter-relationships between science (including technology and medicine) and the public: […] popular representations of science, scientific and para-scientific belief systems, science in schools, history of science, education of popular science, science and the media. (Sage, 2011)

One issue includes an article exemplifying the kind of approach advocated here for television. Christine Knight conducts discourse analysis of low-carbohydrate diet books to highlight unproven evolutionary explanations for obesity: ‘historical narratives and scientific arguments […] are beset with generalisations, inconsistencies and errors’ resulting from ‘use of the primitive as a discursive “blank slate” onto which to project ideals perceived to be lacking in contemporary industrialised life’ (2011, 706).

Most initiatives, however – instead of identifying, elaborating, illustrating, testing and cataloguing pervasive myths – implicitly or overtly accept a deficit model of understanding. This is despite protestations such as the following, from a science communicators’ textbook: ‘The one-way deficit philosophy of

science communication, which was predicated on the idea that the lay person was somehow deficient in his [*sic*] knowledge of science, is now largely out of fashion' (Brake and Weitkamp, 2009, 2). The same source identifies a shift from 'out-dated "Scientific Literacy"' to 'more inclusive public engagement' (4). Change of emphasis seems justified by Wellcome Trust sponsored research into perceptions of cloning, which revealed high levels of scientific literacy concerning biotechnology, and that the more the public knew about the science of cloning the more sceptical they became, expressing grave scepticism towards the trustworthiness of either the scientific community or its regulatory mechanisms. (Franklin, 2000, 227, n.28)

Such insights do not make the public right or wrong but remind that science, like controversies data feeds, is pursued in a political, commercial, economic or military context, and attitudes towards and understanding of these affect reception. That science communicators are trained within science disciplines, or science journalists, equally understandably, exist to simplify and explain results of complex reasoning and procedures – so minor refinements to knowledge invariably become reported as a 'breakthrough' – should raise ethical concerns akin to those surrounding embedded journalism in contemporary warfare.

Journalistic 'balance' assumes stories have two sides; credibility requires neutrality; and fairness gives 'both' sides attention, so one dissenting position receives equal prominence to another 999 researchers' consensus. That many scientists, politicians, and pundits ignore such matters suggests a Public (and Scientists') Engagement in Media Representations agenda is as

important as Public Engagement in Science and Technology. The two need bringing closer together.

Gardner and Young proposed challenging television's version of science to acknowledge informing 'ideologies and conceptions', and opposing views to them, including 'directly economic determinations', such as co-production deals; and 'interaction and overlap' between genres, fictional and factual, as well as thorough analysis of texts and cycles (1981, 171-172). Two decades later, Josephine Anne Stein noted: 'Many PUS activities have become more entertaining and more interactive, but retain more of the traditional "mission to explain" (a phrase often employed by the BBC) than a "mission to understand" in a mutual sense' (no date). Most, she observed, remain entrenched within the scientists' agenda. Although Gardner and Young offered, within constraints of a brief article, analyses of *Horizon* and the costume drama *The Voyage of Charles Darwin* (BBC, 1978), little suggests anything came of their 'larger project' (1981, 171). Media specialists, as well as scientists, still need to address similar issues utilising developments in critical theory and analytical methods and in the context of new controversies and challenges.

Non-solutions (1)

Richard Hammond's Invisible Worlds (BBC Productions/ Discovery Channel, 2010), fronted by a former *Brainiac* presenter, and without the OU's explicit educational mission, was an egregious example of spectacle supplanting science. It is undoubtedly wonderful to see x-ray video of an athlete running, a

cat jumping and landing (its luminescent bones, slowed down, flexing to absorb impact), and a rat arching its backbone to climb a ship's anchor chain. Such vision-extending technology is as marvellous as the first moving pictures. Hammond's repeated claim that 'Now, for the first time' the programme reveals phenomena – incessant rhetoric of technological firsts and superlatives sharing the mind-set of journalistic 'breakthroughs' – underlines that. But x-rays are dangerous. Science, surely, would show how such video works; why it is harmless; even better, explain its development. Otherwise nothing prevents a sceptical media academic averring that supposed evidence may actually be CGI based on manipulated x-ray stills, masquerading as recording – not what technology documents but what such capture would look like if capability existed. Later, infrared videography shows how airborne forest rangers spot distant blazes beyond human vision. Hammond asserts that a certain beetle similarly seeks out forest fires – but offers no reason why. Rather than science, the programme presents successive unrelated phenomena beyond human sight.

Despite efforts and a shift in academic attitudes towards knowledge dissemination, this and associated series demonstrate how little science representation has improved. Here the present author acknowledges his lack of scientific credentials; and stresses that this is not a personal attack on Hammond, although many exist in journalism, satire, and Internet postings around celebrity culture. Not least in Hammond's case these allude to his *Top Gear* (2002-) appearances. This politically incorrect programme was the BBC's most successful export until suspended in March 2015 after fellow presenter Jeremy Clarkson's dismissal. Worldwide reach and profitability had

endured despite condemnation of its celebration of car culture and economic, environmental, and ideological consequences entailed. Its audience appeal and antagonism to critics involved androcentric, Anglo-centric tone that repeatedly attracted publicity resulting from racist, misogynist, and other slurs, often defended as jokes. That aspect of Hammond's image is marginal to television science coverage. It nevertheless contributes. Slight, soft-spoken, nicknamed 'The Hamster' by his overgrown schoolboy co-presenters, Hammond was figuratively younger brother or protected member of the bully's gang. His programmes accordingly construct him as underdog made good as he travels globally, plays with giant machinery, and marvels at technology – an identification figure for boys fantasizing power, and for regressive adults.

The titles, DVD cover and promotion for *Richard Hammond's Invisible Worlds* show half his face in close-up, emphasising one eye. This was an emergent trope in science documentaries. Discovery HD used similar images to advertise its documentary *Stephen Hawking and the Theory of Everything* (2008); and Channel Four (UK) employed near-identical framing to advertise *Brave New World with Stephen Hawking* (2011). Celebrity is a selling point: *Richard Hammond's Invisible Worlds* trades on his *Top Gear* reputation and *Brainiac* presenter role, following *Richard Hammond's Blast Lab* (CBBC, 2010), *Richard Hammond's Journey to the Centre of the Planet* (BBC / Discovery Channel, 2011), *Richard Hammond's Tech Head* (YouTube shorts by ChannelFlip, 2011-), *Richard Hammond's Miracles of Nature* (Oxford Scientific Films and Terra Mater Factual Studios for BBC, 2012), *Wild Weather with Richard Hammond* (BBC1, 2014), and a non-scientific series for the USA, *Richard Hammond's Crash Course* (BBC Worldwide, 2012), punning

on his near-fatal *Top Gear* accident that spawned a best-selling autobiography. Hawking of course is the world's most recognizable scientist.

Vision metonymizes science, connoting precision instruments together with illusory mastery psychoanalytically associated with voyeurism (Metz, 1975; Mulvey, 1975). It further aligns both presenters as possessing super powers. For Hawking – astronomer and theorist – these constitute ability to see, literally and metaphorically, beyond present knowledge; for Hammond, thanks to massive magnification, high-speed videography, image enhancement, recording outside the visible spectrum, and routine illusionism, facility to show the invisible. Indeed Hammond plays with the promise extended by adverts for x-ray specs that boyhood superhero comics featured. A curvaceous woman wearing 1960s retro-fashion clothing walks past; but rather than indulging voyeuristic scopophilia, 'undressing' her as viewers might expect, the x-ray examines her handbag. Self-conscious laddishness – a sexist representation swerves in disavowal, mocking spectatorial complicity – positions Hammond between Hawking as authority and comedian Vic Reeves, Hammond's *Brainiac* replacement, as ordinary bloke. Repeated first-person plural reinforces the ambiguity – 'Now, for the first time, we can see' – meaning scientists, whose achievements Hammond mediates, and viewers whose distracted curiosity he embodies.

Commentary obfuscates while appealing to desire to know. Episodes start with Hammond intoning: Alongside the world we see is a different world, an invisible world of hidden forces and powers that shapes every aspect of life on

Earth. New technology can open a door on that hidden world, revealing its mysteries and showing the true wonder of the world we live in.

The door metaphor positions us *here*; 'that hidden world' – or science disclosing it – *there*, finally uncovered. There is no 'different world'; just reality represented otherwise – epistemological implications of which are ignored. The plural *Hidden Worlds* aligns Hammond with Prospero or Blake's vision of God, who control cosmic forces and shape destiny, reconnecting his supposed scientific mastery with mystical babble from alliances such as astrology. 'Hidden forces and powers' confuses terminology along with popular meanings and synonyms, implying supernatural agency. Who, indeed, hid them? Is there daring transgression in uncovering them? The claim involves tautology: forces and powers of the world shape every aspect of life on Earth – the world. Hick showmanship summons oxymoronic 'true wonder'. We wonder about the unknown; possessors of truth no longer wonder.

The programme contributed to the BBC World of Wonder 2010, officially branded science within the same project as *Wonders of the Solar System* and *Wonders of the Universe*. Moreover, as Cox's university colleague David Kirby warns, *Cosmos: A Spacetime Odyssey* (Cosmos Studios/ National Geographic Channel, 2014), successor to Carl Sagan's original, elicits 'wonder overload' at risk of substituting spirituality for reason and 'transferring the object of reverence from nature to science and scientists' (2015). Instead of widening understanding, television worships scientists as other, enabling

absurdities such as Italy's 2012 incarceration of geoscientists for not predicting an earthquake. For such reasons, and because of OU, Discovery Channel, and Oxford Scientific Films involvement in similarly marketed Hammond productions and experts' presence, however marginal, in these; and because of metonymy through technology and engineering with the UK governments' favouring of STEM (Science, Technology, Engineering, and Mathematics) in schools' curricula and universities' funding; and because *Invisible Worlds* aired on BBC1 at 9.00 p.m. peak time – not a children's channel or before Britain's family viewing watershed – it must be treated as science documentary.

Notable alongside the x-rays is Hammond's verbosity – 499 words in five minutes. Excessive words, superfluous adjectives – 'extraordinary', 'astonishing' – and vague noises and unwarranted atmospheric music, eerie and exciting, render the soundtrack relentless, intrusive, yet distracting. Analogously to conjurors' misdirection to disguise trickery, language summons images that cover gaps in logic and superimpose themselves onto the visuals, discouraging scrutiny. 'Oh! Vest man's back!' Hammond declares, as the athlete enters a shot. 'Yeah, that's how they got the plague on ships. Like that!' as the rat climbs the chain. A cat is described, gratuitously, as 'stroll[ing] away to sleep on the shed roof', and so on. 'You might not think of your pet as a supreme gymnast but that's exactly what it is'. Emphatically, cats are not: a gymnast is a trained human. Second-person address plants misleading notions, while reference to 'precision engineering of a top athlete' comes perilously close to endorsing intelligent design. This precedes *Richard Hammond's Miracles of Nature*, publicity for which, including the DVD cover,

promises to ‘reveal[…] the extraordinary super-powers’ and ‘weird and wonderful engineering solutions’ animals have developed.

Hammond snaps his fingers like a magician, bringing darkness. He re-emerges in chiaroscuro, side-lit, a cold blue hue again echoing the Hawking images. The programme recycles long-standing visual ambivalence towards science as attractive yet frightening, enlightenment shaded by superstition concerning dark powers. Famous precursors include paintings by Joseph Wright of Derby: *A Philosopher Giving a Lecture on the Orrery* (1766) and *An Experiment on a Bird in an Air Pump* (1768).

‘This is one of the world’s most advanced x-ray machines’, Hammond announces, not specifying its advancements. It might help if viewers could see it. Shimmery music accompanies slow tracking over isolated parts of ill-defined apparatus in semi-darkness. A programme predicated on showing everything displays a machine as – shiny and metallic! Visual rhetoric parallels cinema’s gendered fetishization of the female body to assert mastery – the controlling gaze objectifies and anatomizes what is both feared and unknown (Mulvey, 1975). ‘What it allows seems like pure science fiction’: odd comparison in the context of scientific rationality. Besides, what does ‘pure’ denote when ‘science fiction’ hybridizes technology with fantasy?

The parkour athlete appears, among hard surfaces with grey, contrasting tones desaturated towards monochrome, consistent with x-ray imagery. ‘For the first time, we can see exactly how the body works in motion’ – ‘can see’: presumably nothing anatomists have not known for centuries – ‘and we can explore some of the mysteries of the inner workings of everything’. The claim

is self-cancelling: ‘some of’ qualifies ‘everything’. Cutaways to a foot and ankle, then knees, imply subsequent x-rays show the joints moving. Hazy and blurred, demonstrating no evidential status, they reveal nothing to the untrained eye. Edits between conventional filming and x-rays employ an unwarranted shudder created by displacement, superfast cross-cutting and double exposure, alternate red and green tints, and accompanying, non-diegetic, scratched record sounds as further distraction.

Examination suggests what are shown are screened-off parts of *different* people receiving short bursts of radiation, slowed down. Intercut slow-motion shots of the athlete, accepted as audio-visual convention, disguise this. Presumably ethical issues around zapping humans and cats are inapplicable to rats and lizards, fully x-rayed in real time. Smaller animals may face less risk because they absorb less radiation. Perhaps their short life spans preclude problems associated with exposure having time to develop. We are not told.

Tensions between such discourses and practices perpetuate ambivalence towards science, causing mystification. While Public Understanding involves endless debate between scientists and journalists predicated on outmoded process models of communication – if scientists used simpler language and familiar examples, and journalists comprehended risk and probability, all would be well – textual analysis demonstrates relatively unsophisticated television studies approaches may yet offer worthwhile contributions. *Invisible Worlds*, substituting spectacle for science, like the Phantasmagoria before it just shows skeletons dancing.

Non-solutions (2)

More troubling, given OU involvement, is *Wild Weather with Richard Hammond*, illustrating wind, water, and temperature. Further nonsensical talk evokes ‘invisible force’ – on this occasion, wind (which empirically is visible, indexically and metonymically: at time of writing, branches stir and grass ripples outside, while clouds scud across the sky and fallen leaves lift and tumble). The programme concluded wind is ‘just air rushing from one place to another’. This follows describing wind as a ‘force’ – untrue, although moving air possesses force – that ‘causes weather’. From any scientific, pedagogical, or popularizing perspective only confusion is likely from conflation, simplification, transference, transposition, reversal of logic, and tautology.

All weather is ‘wild’. Neither cultural product nor tameable, it is nevertheless influenced by climate change: a central issue this programme, relentlessly pursuing thrills, ignores. Despite the title, Hammond presents mostly not wild weather but human replications. These include his entry into a £23M tornado simulator, ‘actually the world’s first hexagonal wind tunnel’. No perceptible irony accompanies this fatuousness, delivered as though six-sidedness or recurrent insistence on temporal priority were significant. Another example features Hammond’s supposed attempts to persuade a camera drone operator to hover expensive equipment above a fire column produced by pyrotechnicians flown into Australia to pour flammable spirit into carefully arranged baking trays and ignite it; the gee-whiz of the drone nearly eclipses the demonstration it enables.

Repeated reference to the crew – untypical of factual programmes – contradictorily reinforces implicit claims of documentary capturing of actuality, naturalization of technical events as somehow not profilmic constructions. There is, again, a sense of laddish community, asserted masculine competitiveness, within the BBC's famously strict health and safety guidelines (defiance of which Hammond's persona embodies since his *Top Gear* dragster crash). Macho, dismissive pseudo-rebellion manifests in removing an arm sling, worn as 'just a precaution' after a blast lands Hammond on the ice outside Mount Washington observatory. Here the most powerful gust ever was recorded – 80 years previously, although superlatives trump relevance. His team remain unharmed. The sequence illustrates nothing except winds blow off hats and make people slip, Hammond and crew supposedly take risks for audiences' elucidation, and no-expenses-spared expeditions to where records were broken somehow enhance curiosity and understanding. The most valuable aspect is indoors explanation (not demonstration) of why mountaintop winds exceed those at sea level – because of constriction between high land and the troposphere, analogously to how a squeezed hosepipe sprays water. Each hour-long episode makes just three or four imprecise points across drawn-out sequences.

Daredevil Hammond, who in the desert raises dust devils *Top Gear*-style by skidding cars in handbrake turns, is a boyish identification figure with seemingly huge physical power and mystical control. X-ray vision penetrates invisible worlds. Having defied death he handles dangerous forces, emerging largely unscathed. He combines Peter Parker's ordinariness with the alter ego of scientific know-how. He shares Clark Kent's journalistic inquisitiveness with

ability to withstand a hurricane. The programme mimics Bruce Wayne's gadgetry, showmanship and budget allowing a mortal without paranormal abilities to adopt a persona who attracts attention while disguising his 'real' self, into which boys, or nostalgic men, project fantasies. Spectacular globetrotting magically transports Hammond instantaneously between continents; sci-fi-style captions specify locations. A re-enacted Oedipal scenario renders school science or nature itself the Law being challenged. The third *Miracles of Nature* opens with Hammond finally stating it: 'We've all dreamed of having super-powers'.

Promising to 'explore' and 'investigate', Hammond instead contrives spectacles. Purported 'experiments' are not: outcomes are known. Demonstration of spiralling flames in controlled ignition to replicate bush fires convincingly explains local factors yet ignores global conditions – planetary rotation – making winds curve. This is in spite of earlier explanation of how standing with one's back to the wind while observing cloud movements can enable weather prediction, which acknowledged that directions require reversal in the Southern Hemisphere (but did not explain why). Flames rise in 'What scientists call a vortex', as though no layperson knows the word or, in this patronizing re-inscription of *Two Cultures* combined with *Reader's Digest* 'Improve your word power', Vorticist art and poetry never existed.

Alternative approaches emphasise these programmes' characteristics and difficulties. *Quantum Mechanics* (BBC Scotland for BBC4, 2014) was a peripatetic illustrated lecture by a Professor of Public Engagement employing analogy rather than demonstration. Personalities – Planck, Einstein, and

others – featured to structure narrative around conflict. Jim Al-Khalili presented concepts beyond most viewers, in a ‘standing on the shoulders of giants’ history of ideas. The theory involved assertion and little clear explanation. Hammond by contrast names neither theories nor historical scientists.

Britain’s Wildest Weather (Channel Four, 2014) echoes Hammond’s title. Although lacking his OU endorsement and concerned with human interest stories from the year’s meteorological events, its voice-over narration and interviews were more interested in phenomena than personality, followed a global warming agenda, and explained causes. The same December night saw *Snowstorm: Britain’s Big Freeze* and *The Floods that Foiled New Year* (both More4), unsurprisingly after the warmest year recorded – a superlative Hammond ignored. *Climate Change by Numbers* (BBC4, 2015) featured eminent mathematicians, like Hammond hopping between locations, who explained how scientists provide data, criteria make it meaningful, and theories and predictions follow, to insist mathematics is key to policy given impossibility of experimentation.

These examples, unlike Hammond’s, occupied minority channels. Whereas statute obliges UK terrestrial broadcasters to present factual science, the BBC, dependent on BBC1 ratings to justify continued licence funding, faces similar pressures to commercial channels for popularity. While quality, rigour, and specialization mark attempts by aforementioned titles to grapple with complexities of public understanding, BBC1 sacrifices its audience advantage

by fulfilling regulatory requirements minimally, treating science as entertainment.

Public reception involves more than flawed communication by scientists and professional intermediaries, or audiences' ignorance and misconceptions. Given Public Understanding's educational remit, it seems reasonable to suggest an analogy with attempting to improve teaching without accounting for learners' needs, motivations, practices, knowledge, and understanding: '[D]eciding how to teach without first studying how people learn is like giving an answer before one has heard the question' (Sotto, 2010, 41).

Non-solutions (3)

Successful educators understand, however, that failing to challenge beliefs patronizes the learner. Each *Miracles of Nature* opens with Hammond intoning: Humans are always trying to be better. Brighter. Faster. Stronger. Tougher. It's one of the things that makes us human. But nature has spent three and a half billion years producing ingenious answers to life's questions. So a lot of the problems we're trying to solve have already been solved by evolution. Meaning the animal kingdom is teeming with bright ideas.

Deft footwork acknowledges evolution (although two of the three episodes avoid further mention until the end) yet sidesteps explanation while maintaining 'natural' competition as teleology for progress. Alongside politically ideological ramifications, Hammond's phraseology reinstates an older natural order: an 'animal kingdom' essentially different from humankind.

Simultaneously nature is divine: personified as a sentient creative inventor with ‘ingenious answers to life’s questions’ – intelligent design rather than random survival of the fittest. The Deist notion of a master clock maker leaving humans to complete His work, an Enlightenment philosophy beloved of several founding fathers, clearly plays to the US market. Hardly surpassing *Invisible Worlds*’ superstition, such compromise and confusion is, scientifically, an utter mash-up. Rather than presupposing a deficit model, whereby the audience lacks knowledge the programme supplies, Hammond’s discourse casually supports regressive convictions.

Miracles of Nature depends on CGI. Geese fly parallel to Hammond, matching his speed and seemingly close to the camera speeding alongside his E-type Jaguar along a runway: *Top Gear* plus ‘nature’. Hammond narrates links to-camera while ambling among Victorian museum display cabinets that multiply thousand-fold as the camera rises in simulated continuation of a reverse crane shot: the effect ignores the taxonomy grouping stuffed creatures within such exhibits, merely to reinforce the banality that many species are out there. Emphasised are stunts, extreme transportation and big machinery: the first fifteen minutes see Hammond paragliding with vultures in South Africa, then descending off Hawaii in a submarine shaped according to their body-to-wing ratios. The programmes foreground artificiality, not in any Brechtian sense to question their epistemology, nor honestly to confirm their highly constructed representations, but – to the extent viewers notice – to celebrate their implication with and mastery of technology. An Alaskan forest transforms into Britain’s Forest of Dean. There follows in-shot transition between temperate English woodland and simulated far northern scenery, using either time-

honored profilmic techniques – marble dust on the track, vegetation sprayed to mimic snow – or CGI similar to that in *Frozen* (Buck and Lee, 2013). In a science context such uncertainty is unhelpful. Elsewhere, non-diegetic whirring, buzzing, hissing and percussion accompany zooms, pans and cuts in the filming, and movements onscreen of hi-tech devices, further confusing pro-filmic reality and fabrication, science-fiction conventions and recorded demonstration, undermining everything's evidential status.

Moreover, the purpose of indexical footage remains obscure. 'Is this really necessary?' Hammond asks while being winched into an aquarium containing repulsive hagfish. Presumably some mechanical means ordinarily agitates them into producing slime as raw material for advanced high-tensile fibres. *Is* it 'really necessary'? Why *should* one presume?

'This is the first time a giraffe has ever had its blood pressure monitored in this way', Hammond intones as veterinarians, evidently expert, monitor a giraffe's blood pressure, although without indication of methods used before. 'This is the first incarnation of your G-RAF suit. What have I and a giraffe got in common?' The answer: he is wearing a pressure suit that keeps fighter pilots conscious despite massive G-forces, analogously to how a giraffe's cardiovascular system prevents blacking out when it lowers its neck to drink. When a later version is demonstrated in – Hammond announces – 'the world's largest and most powerful centrifuge', the irrelevant superlative distracts from questions of military funding and application. So too does reference to 'the highest helmet drop tower in Britain', where safety headgear is tested, prior to showing the work of a bomb disposal officer (protective technologies sharing

qualities with woodpecker skulls). Another episode features an army tank with night-vision invisibility and deceptive shape-shifting capabilities. Its complex photoelectric arrangements confirm Hammond's oracular revelation: 'Every one of us experiences the world through our senses'.

Omissions are as significant as inclusion. 'Animals have inspired human inventions at the very frontiers of science' is merely facile without demonstrated causality or engagement with research planning, funding, methodology, or dissemination. Military applications hence become inevitable, natural, justified by the evolution presupposed but unnamed outside opening and closing segments – or in one episode during a transition (convenient for a commercial break) – easily edited for different territories. In a science programme titled to equate nature with 'miracles', in which a stickler for English pronunciation calls aeroplanes 'airplanes' – despite bickering amiably with a Californian oceanographer over whether 'buoy' sounds like 'boo-ee' or 'boy' – unqualified assertions occur such as when rain pelts a jungle butterfly: 'Lucky, then, that the water just beads up and runs off'. Such luck, in a benevolent universe, extends to us – Hammond in this series names humans, including inventors, as 'we', but scientists as 'they' – as he links humorously to a sequence in which a mobile phone is to be exposed to plasma rays in preparation for similarly hydrophobic properties. But the programme avoids what plasma rays are, how they prepare surfaces for coating, how a butterfly wing's microscopic structuring can be adapted to paint, and how micro-thin covering is applied to all surfaces, internal and external, of a complex electronic device.

‘Just imagine if any electrical device could be waterproof’, Hammond suggests: ‘No more water damaged phones. No more flood damaged televisions. And no more coffee damaged keyboards’. One might add: no more profitable insurance plans or wasteful turnover of semi-disposable goods. Evading why this technology exists, and who funds it, the programme nevertheless parallels *The Man in the White Suit* (Mackendrick, 1951), showing Hammond striding in just such an outfit as water, coffee, ketchup, mustard, and baked beans splatter him yet slide off spotlessly. Whether this is genuine or, more plausibly, jokey CGI, the allusion indicates postmodern knowingness within the production chain – there are four credited researchers but no scriptwriter – yet the programme explicitly references neither the Ealing comedy nor economic and ideological contradictions the film astutely recognized.

‘And all thanks to the South American rain forest and one small butterfly’. No clearer causally is why subsonic transmission through rock as a positioning signal for trapped miners had to wait, as the programme asserts, for the discovery that elephants communicate through earth vibrations, as if instrumental seismology has not existed for decades. ‘It goes to show that sometimes – most times – there’s an animal out there somewhere that can outperform the best that we humans have to offer’.

Hammond is, bombastically, Voice of God – Nichols’ term for off-screen commentator (2001, 13-14) – and presenter; but the programme avoids accessed voices beyond occasional experts who mount a show for Hammond, the audience’s stand-in, to be ‘astonished’ – a frequent response.

He is co-observer, not expert witness, inquisitor, explicator, theorist, or interpreter. According to Silverstone, science can be, and is, represented as an orderly goal-directed activity, a political and social problem solver, or a disastrous and runaway technocracy. It can be, and often is, presented in terms defined or legitimated by scientists; and it can be, and often is, presented in terms defined and legitimated by the requirement to tell a good story, or to engage in or generate controversy. (1991, 108)

Hammond's programmes match none of these. Scientists remain at arm's length, engaged with minimally: because they control a piece of large kit he wants to get inside, can take him close to wild creatures otherwise impossible to track, or can train an animal to behave astonishingly. Such interactions substitute scientific discourse with pleasantries, Hammond's expressions of trepidation or delight, or self-deprecation as when his two-syllable submarine 'handle' (purpose unexplained) is 'Hamster'. Hammond abandons documentary's 'discourse of sobriety', assumed unquestioningly by Silverstone, as explained by Nichols: audiences expect to be able both to trust to the indexical linkage between what we see and what occurred before the camera *and* to assess the poetic or rhetorical transformation of this linkage into a commentary or perspective on the world we occupy. We anticipate an oscillation between the recognition of historical reality and the recognition of a representation about it. (2001, 39, original emphasis)

Nor do these programmes, muddying both aspects, conform to any of Nichols' documentary modes (99-137). They engagingly contradict 'stuffed', 'fossilized' knowledge connoted by identical museum cabinets – previously fixed secrets

scientists unlock to create technological ‘miracles’. But in confusing science with metaphors necessary to explain it to non-specialists, they reduce it to meaningless spectacle and assert superiority over nature, distracting from anthropogenic threats to planetary viability.

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[1] The lecture is neither published nor otherwise officially available.